

1 1. A method for maintaining cell viability in a microfluidic device, the method
2 comprising the steps of:
3 providing a cell proximate a first side of a porous membrane of the microfluidic
4 device; and
5 providing a media comprising a cell nutrient proximate a second side of the
6 porous membrane, wherein the porous membrane is adapted to prevent the cell from
7 passing therethrough, to substantially prevent the media from flowing therethrough, and
8 to provide diffusive communication between the two sides to allow the cell nutrient and a
9 cell product to pass therethrough.

1 2. The method of claim 1, further comprising the step of detecting the cell product in
2 the media.

1 3. The method of claim 2, wherein detecting the cell product in the media comprises
2 detecting at least one of an electrochemical signal and a luminescent emission.

1 4. The method of claim 1, wherein the porous membrane comprises a material
2 selected from the group consisting of glass fiber, polycarbonate, polyethylene,
3 polypropylene, polystyrene, polyimide, cellulose, nitrocellulose, cellulose esters, nylon,
4 rayon, fluorocarbon, perfluorocarbon, polydimethylsiloxane, polyester, acrylics,
5 acrylonitrile-butadiene-styrene; polyoxy-methylene; polyarylate, polyvinylchloride,
6 PBT-polyester, polybenzimidazole, acetal copolymers, polyimides, ethylene-
7 chlorotrifluoroethylene, PET polyesters, ethylene-tetrafluoroethylene, fluorinated ethylene
8 propylene, polyphenylene sulfide, polyethylene, polyurathanes, polyketones, polychloro-
9 trifluoro-ethylene, polyvinylidene fluoride, polyethylene terephthalate polyesters,
10 polypropylene oxides, polypropylene styrenes, polyether-ether ketones,
11 polytetrafluoroethylene, polyarylether sulfones, polyamide-imides, polyphenylene
12 sulfides, polyarylates, polymethylpentene, polyketones, polysulfones, polyphenylene
13 sulfides, PBT polyesters, and/or alloys of polymers.

1 5. The method of claim 1, wherein the step of providing the media comprises
2 flowing the media along at least a portion of the second side of the porous membrane.

1 6. The method of claim 5, wherein flowing the media comprises intermittently
2 flowing the media.

1 7. The method of claim 1, further comprising the step of controlling a temperature of
2 the cell.

1 8. The method of claim 1, further comprising the step of controlling a concentration
2 of the cell nutrient in the media.

1 9. A method for loading cells into a microfluidic device, the method comprising the
2 steps of:

3 depositing a cell sample into a common duct opening of the microfluidic device;
4 and

5 subdividing the cell sample, so that at least a first portion of the sample flows into
6 a first cell duct in fluidic communication with the duct opening and another portion of the
7 sample flows into a second cell duct in fluidic communication with the duct opening.

1 10. The method of claim 9, wherein the step of subdividing the cell sample comprises
2 flowing at least a portion of the cell sample through a manifold interdisposed between the
3 duct opening and at least one cell duct.

1 11. The method of claim 9, wherein at least one of the sample portions flows by
2 capillary action.

1 12. The method of claim 9, wherein the step of subdividing the cell sample comprises
2 substantially uniformly dividing the cell sample.

1 13. The method of claim 9, wherein the step of subdividing the cell sample includes
2 applying a pressure differential.

1 14. The method of claim 9, wherein the cell sample comprises a substantially
2 isopycnic solution having a density substantially similar to a density of cells in the
3 sample, such that the cells remain substantially in neutral suspension in the isopycnic
4 solution.

1 15. A microfluidic device for maintaining viability of a cell, the device comprising:
2 a cell duct plate, defining at least one cell duct therein;
3 a porous membrane having a first side bounding at least a portion of the cell duct;
4 and
5 a flow channel plate, defining at least one flow channel therein, at least a portion
6 of the flow channel being bounded by a second side of the porous membrane, wherein the
7 cell duct and the flow channel are in diffusive communication through the membrane and

the porous membrane is adapted to prevent a cell in the cell duct from passing therethrough, while allowing a cell nutrient in the flow channel and a cell product in the cell duct to pass therethrough.

16. The microfluidic device of claim 15, wherein the cell duct plate comprises a material selected from the group consisting of glass, fused silica, quartz, silicon, and organic polymers.

17. The microfluidic device of claim 15, wherein the flow channel plate comprises a material selected from the group consisting of glass, fused silica, quartz, silicon, and organic polymers.

18. The microfluidic device of claim 15, wherein the porous membrane comprises a material selected from the group consisting of glass fiber, polycarbonate, polyethylene, polypropylene, polystyrene, polyimide, cellulose, nitrocellulose, cellulose esters, nylon, rayon, fluorocarbons, perfluorocarbons, polydimethylsiloxane, polyester, acrylics, acrylonitrile-butadiene-styrene; polyoxy-methylene; polyarylate, polyvinylchloride, PBT-Polyester, polybenzimidazone, acetal copolymers, polyimides, ethylene-chlorotrifluorethylene, PET polyesters, ethylene-tetrafluorethylene, fluorinated ethylene propylene, polyphenylene sulfide, polyethylene, polyurathanes, polyketones, polychlorotrifluoro-ethylene, polyvinylidene fluoride, polyethylene terephthalate polyesters, polypropylene oxides, polypropylene styrenes, polyether-ether ketones, polytetrafluorethylene, polyarylether sulfones, polyamide-imides, polyphenylene sulfides, polyarylates, polymethylpentene, polyketones, polysulfones, polyphenylene sulfides, PBT polyesters, and alloys of polymers.

19. The microfluidic device of claim 15, wherein the porous membrane defines a pore size having a diameter selected from the range of about 1 nanometer to about 100 micrometers.

20. The microfluidic device of claim 15, wherein the porous membrane has a thickness less than about 200 microns.

21. The microfluidic device of claim 20, wherein the thickness is greater than about 5 microns.

22. The microfluidic device of claim 15, wherein the porous membrane comprises an interfacial layer disposed between the cell duct plate and the flow channel plate.

- 1 23. The microfluidic device of claim 15, further comprising a plurality of cell ducts in
2 combination with a plurality of flow channels.
- 1 24. The microfluidic device of claim 23, wherein a number of cell ducts is equal to a
2 number of flow channels.
- 1 25. The microfluidic device of claim 23, wherein the cell ducts are generally radially
2 disposed about a common duct opening.
- 1 26. The microfluidic device of claim 23, wherein at least two flow channels are not in
2 mixing fluidic communication with each other.
- 1 27. The microfluidic device of claim 23, wherein at least two flow channels are in
2 mixing fluidic communication with each other.
- 1 28. The microfluidic device of claim 15, wherein at least one of a cell duct and a flow
2 channel further comprises a valve.
- 1 29. A microfluidic device for retaining a cell sample including a plurality of cells, the
2 device comprising:
3 a plate defining:
4 a common duct opening adapted to receive the cell sample; and
5 at least two cell ducts in fluidic communication with the duct opening, so
6 that at least a portion of the cell sample can flow into a first cell duct and another
7 portion of the cell sample can flow into a second cell duct.
- 1 30. The microfluidic device of claim 29, wherein the plate further defines a manifold
2 interdisposed between the duct opening and at least one cell duct.
- 1 31. The microfluidic device of claim 29, further comprising a pressure differential
2 source adapted to induce the flow of at least one of the cell sample portions into at least
3 one of the cell ducts.
- 1 32. A system for monitoring an activity of a cell, the system comprising:
2 a microfluidic device comprising:
3 a cell duct plate defining at least one cell duct therein;
4 a porous membrane having a first side bounding at least a portion of the
5 cell duct; and
6 a flow channel plate, defining at least one flow channel therein, at least a
7 portion of the flow channel being bounded by a second side of the porous membrane,

8 wherein the porous membrane is adapted to prevent a cell in the cell duct from passing
9 therethrough, while allowing a nutrient in the flow channel to pass therethrough and
10 allowing a product of the cell to pass therethrough;

11 a pump adapted to induce flow of a nutrient media through the flow channel to
12 support cell viability in the cell duct;

13 a controller adapted to control flow in the microfluidic device; and

14 a sensor adapted to detect at least one of the cell and the product of the cell.

1 33. The system of claim 32, wherein the sensor comprises at least one of an
2 electrochemical detector and a luminescence detector.

1 34. The system of claim 33, wherein the luminescence detector comprises a
2 fluorescent reagent, an excitation light source adapted to provide radiation having a first
3 radiation wavelength range, and a detector adapted to measure an intensity of emitted
4 light in a second radiation wavelength range, the second radiation wavelength range
5 being different from the first radiation wavelength.

1 35. The system of claim 33, wherein the electrochemical detector comprises an
2 electrode adapted to measure at least one of pH and dissolved oxygen.